For a new social gender-based approach to local geothermal development

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ABSTRACT

In geothermal feasibility studies and project developments, the classical Environmental and Social Impact Assessment (ESIA) approach is to define the project in terms of technology based on « hard science » (geology, geophysics, drilling and reservoir studies, etc…), and to detail its economic characteristics, then to include an environmental and social impact study. Such an approach may later lead to challenges, once the industrial development of the geothermal site is started, as local populations may feel uninvolved in an engagement that modifies their own land and life.

We propose to develop a new social approach to geothermal initiatives in which the development agent would start by analysing the needs of the population living on the site and would first answer these needs, before any further development is engaged. In this process, rather than dealing with the local traditional male chiefs, the idea is to take into consideration the gender issues and to work in close liaison with the women, who are the most involved with the water and energy issues, as they usually are the ones in charge of providing these goods and services at household level.

The approach proposes to develop a first stage through which information and communication programs, coupled with appropriate education processes of all generations, would facilitate the establishment of a system that would first answer the needs for water and energy of the local population. The "Geothermal Village" concepts is based on this approach. According to this approach, further geothermal development would be considered in a totally different way, with a real appropriation of a process which besides promoting community ownership, would ensure the indigenous population is not left aside in the development taking place in their own land.

Specific characteristics of geothermal development allows for both modular and diversified energy applications (from low to high temperature, as well as from electricity thermal water production). This creates an opportunity for development agencies in Africa to include such social considerations in their approach to energy initiatives. A research project is being undertaken to outline these concepts and approaches in order to pass from academic considerations to practical terms of references for use by development agencies and operators in future guidelines and principles for social impact and assessment.

1. INTRODUCTION

Geothermal, a renewable, economic, emission free, sustainable and with a continuous and regular energy output, is unique for its qualities with respect to many other non-renewable and renewable energy sources. Digging heat from the subsoil, geothermal energy is also naturally linked with the land tenure and ownership.

In most countries, the geothermal energy resource is considered as similar to a mining deposit, and placed by the concerned administration under legal status derived from the mining law. It is the role of the central administration of the state to allocate the research and the implementation permits. The local population has little to say in this process, the only opportunity being the Environmental and Social Impact Assessment (ESIA), an obligation by default for most countries and financial agencies.

However, despite these advantageous environmental, economic and legal characteristics, several geothermal projects tend to encounter difficulties in their implementation or development due to social tensions with the local population, notably the rural communities that have lived on site for generations. They are frequently nomadic populations along the East African Rift Valley, i.e. not permanently living on a given spot, but moving according to climate or other reasons. It is therefore not always easy for the project promoter to identify the right community to negotiate with. Even after a successful ESIA, and a consequently well managed Social and Environmental Management Plan (ESMP), it often happens that unforeseen social unrest develops on geothermal sites being developed.

The aim of this paper is to analyse the nature and causes of these tensions and to propose a new approach to geothermal field feasibilities and developments based on an approach in which identifying the local population needs is not treated as a study annexed to the project, but an integral part of the project's overall conception.

1.1. The experience of two different approaches to geothermal project

For the sake of approaching this question in the detail of a project conception and implementation, it is wise to start with an overview of geothermal energy development conditions in general. One can at this stage distinguish two different cases, in which the natural physical conditions determine rather different social approaches: the low enthalpy project in sedimentary basins on one side, and the high enthalpy project approach in volcanic areas on the other side (Fig.1).

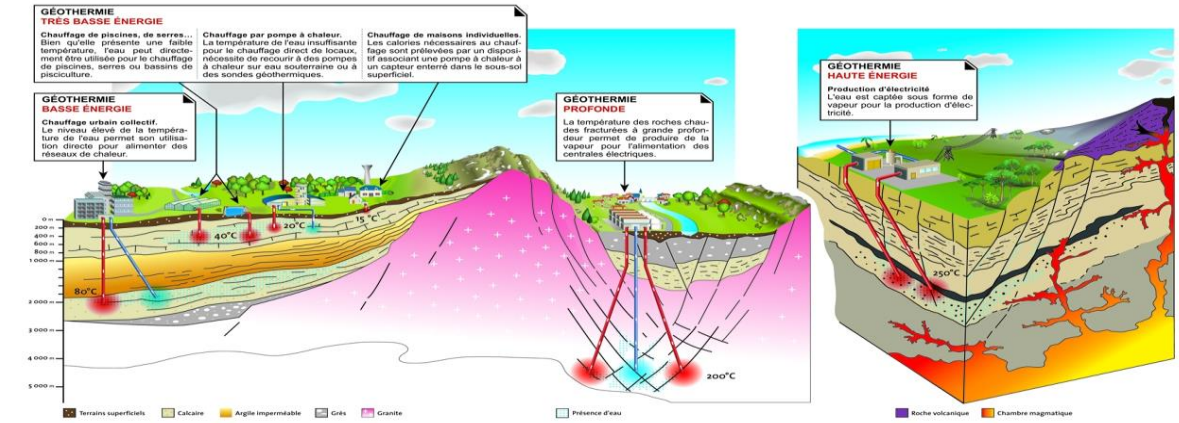

Figure 1: Major types of geothermal energy projects and developments: low enthalpy projects in normal gradient areas and high enthalpy projects in volcanic areas. The first are built in order to serve local needs on site, whereas the second serve the electric grid (from BRGM).

1.2. The low enthalpy project in sedimentary basins

In this case, the continuity of the geothermal resource allows for the development of projects in nearly all sites in rather large areas of the basin. The initiation and development of a given project that first relies upon the energy demand (in this case demand for heat) on this given site (Fig.2). The first approach on the engineering and/or developer is hence to start with an inventory of the needs, that is to rely upon precise enquiries directed at the local population, at the level of individual or consumers groups (housing, compounds, schools, swimming pool, industry, tertiary activities (offices, commerce…).

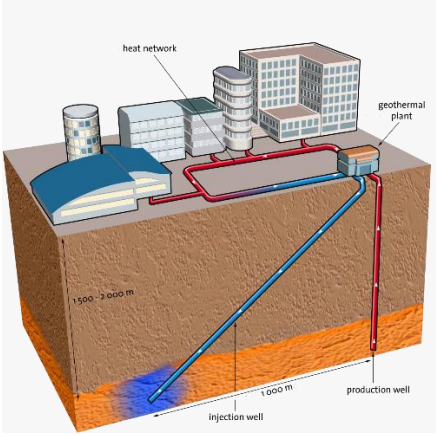

Figure 2: Geothermal doublet serving the needs for low enthalpy energy for various users, including housing, offices, swimming pool, etc. with cascade use of the energy (from BRGM).

The engineering of the project is then basically conceived in order to answer the needs of the local population and the successive development and management plan of the project is aimed at serving their needs in the most efficient and economical way (Varet, 1982).

Therefore, projects built under such approach very rarely encounter tensions or conflicts with the population on the site of the geothermal project. It is rather considered as their own, as they benefit in the long term from the outcomes it generates. This was also shown by Mariita (2010) in the case of low enthalpy geothermal developments in Kenya.

1.3. The high enthalpy project approach in volcanic areas

In this case, the geothermal resource is linked with specific geological conditions that direct the selection of the site suitable for development. An exploration program at national or regional level leads to the selection of sites suitable for pre-feasibility studies, and the results allow for engaging feasibility studies including the drilling of deep exploration wells and the preliminary design of the geothermal plant. It is at this stage that the ESIAF approach is engaged and that the local population is consulted (Fig.3). That is, the project is basically conceived without them and they act as marginal adjustment factors, to be considered in terms of "compensations" for what impacts their lives.

The benefit of the project is huge, but counting at national or even regional level. However for the local population, which was traditionally living on the site, even the compensation originally set, may, as the project develops, progressively appear as unsatisfactory, as they watch their land disappear into the development. The idea is hence to find a way for the local population to become part of the project at the early stage of its definition (Mariita, 2002).

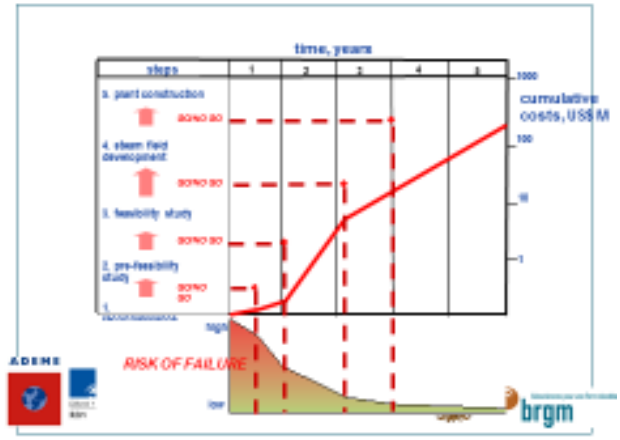

Figure 3: Scenario for the development of a 100MWe geothermal plant, from early conception to development. The ESIA (i.e. the first social studies) is engaged only at the feasibility stage (from BGR).

1.4. Proposal for a "blended" approach benefiting from these different experiences

This difference in treatment of the social dimension of the project concerning local communities present on site directly depends upon the characteristics of the resource and of the concerned technological application. Differing from electricity that can feed the grid, the heat cannot be transported for long distances and is necessary, or at least advantageously consumed on site (see Fig.2). Low enthalpy projects hence necessitate intrinsically a locally-based approach that implies "by construction" the identification of the local needs and the implementation of the geothermal distribution system, where the various uses of energy – notably the "en cascade" uses – are clearly defined and shared for the benefit of the various local users (J.Varet, 2013). High enthalpy projects, on the contrary, may develop in a way that is totally "external" to the local people. The target population may be eventually compensated for the inconvenience but not involved in any way in the project operations as the plant may even be automatic and piloted from remote central electricity company offices.

But this basic difference may not be as huge if projects are planned differently, as on one hand heat and geothermal fluids can also be transported by pipes at certain distances (up to several tens of kilometres without energy loss thanks to well insulated piping), and on the other hand, local use of the electricity, not only of the heat, can be promoted – or answer to a pre-existing local demand, in almost any resource site. There is a tendency, in many high enthalpy geothermal sites, to attract energy consuming enterprises in the vicinity of the geothermal power unit.

The experience acquired in many parts of the world, including France, Italy, Iceland and New Zealand shows that a "blended approach" including the search for various uses of energy around the projected or existing geothermal site (including electricity, industrial heat, household and tertiary warming or cooling, with cascade use of the heat and finally use of the geothermal fluid itself for bathing or other medical or touristic applications) provides the best economic solution. Additionally, it is also the most welcomed in terms of social life as it creates links and interdependence among people in the concerned communities.

2. THE SOCIAL AND GENDER ISSUE APPLIED TO GEOTHERMAL

2.1. Overview of energy and water social issues

The development benefits of geothermal energy stem from both direct and indirect uses; namely the provision of heat and increased access to electricity. Direct uses, often done through the use of off-grid or mini-grid technologies, usually occur within a 50 km radius and include eco-tourism (hot baths and spa), small-scale liquid and dry milk processing (pasteurisation, etc.) and agriculture (greenhouses, crop drying, fish drying, livestock rearing), while also enhancing resilience to climate change impacts. This technology can provide electricity to even the most remote communities on a much smaller scale, either for individual households, small communities and small businesses. It is the kind of development promoted by Géo2D together with GDC, where Geothermal Villages are developed around geothermal site, often found off-grid as shown below (see Figure 6). Indirect uses on the other hand arise mainly from electricity production and access to electricity which in turn enable and improve the delivery of social and business services from a wide range of village-level infrastructure (e.g. schools, markets and water pumps) while improving the productivity of industrial activities. The use of geothermal energy is expected to improve food security, create gainful employment, reduce drought-related losses and provide alternative sources of income streams.

Electricity access therefore has a positive impact on the economy. It allows businesses to use powered machinery and stay open even when it gets dark, so longer, thus increase jobs due to improved business opportunities. School boys and girls can also study after dark using electricity and all including women and men avoid using for lighting, the kerosene lamps with toxic fumes so an improvement in health. The smoke from using biomass (such as wood, charcoal, animal dung, kerosene) is equally reduced with the same positive results on health. Available figures indicate that death associated with the use of these energy forms in Sub Sahara Africa is 400,000 per annum. Time spent, often by women and girls, in looking for these cooking resources is also saved. Time spent looking for treatment and on treatment is thus also reduced. Health conditions of men, women, boys and girls can also be enhanced due to improved lighting and storage conditions in medical centres as well as enhanced access to health information, thus again saving time spent by local communities and medical practitioners on addressing health issues. Firewood use as a source of energy also results in deforestation.

Boys and men would also save on time previously spent looking for pasture and water for livestock as the geothermal development would make it possible to access water within close proximity of where they live. Information access through the use of radio, television and mobile phones powered by electricity can educate, enhance social mobilisation as well as business activity. Electricity access also improves safety, especially for women and girls, as they would no longer need to make trips through isolated areas in search of wood and water, where conflict and rape remain constant and real threats.

Water interventions also effectively address gender inequities. Collecting water from a nearby abundant source saves time and effort, leading to significant benefits for women and children, who have the burden of handling roles related to access and use of water. Women can spend more time and effort on other activities such as social investment and caring for their children. The problem of women having backaches resulting from carrying heavy loads of water and firewood for long distances is also reduced. By improving family health and access to domestic water, they lighten women's household burden, enabling them to engage in more productive activities, access productive resources and enhance their participation in decision-making processes at all levels, thus promoting gender equality. Increased social investment results in increased participation in productive activities such as farming, livestock, fishing, trading and microfinance. Women are a critical force in rural development and should be viewed as agents of change who can positively influence community decisions for transformative change. School going children also have more time for homework and play.

2.2. Gender issue related to geothermal energy

Gender is defined as the socially-constructed roles of and relationships between men and women in a given culture. In all societies, men and women are assigned tasks, activities and responsibilities according to the sex (that is according to their biological difference). The gender division of labour varies from one society and culture to another and changes with time. Geothermal initiatives have a direct impact on gender. While global systems are continuously evolving, gender is increasingly relevant and vital in the development sector.

Geothermal energy can thus help increase household access to modern energy services, reduce energy poverty, improve quality of life, empower women, create jobs, invigorate economies, bridge urban-rural inequality and migration, protect the environment, reduce natural resource conflicts (e.g. around firewood collection and water points). More benefits are expected from the initiative's trickle-down effect. Due to the expected outcomes, geothermal interventions thus also have an impact on gender roles and relations, meaning the initiatives should be addressed from a gender perspective.

Gender considerations in energy projects will ensure that the investments are more effective, have a higher development impact and support initiatives such as 1976 Convention on the Elimination of Discrimination Against Women (CEDAW) and the Beijing Platform of Action which advocate for increasing the role of women in poverty reduction, in the economy, power and decision-making and in institutions. In the case of this study, it involves exploring and analyzing, community communication related to geothermal energy and household energy, from the starting point that women and men have different roles, activities and responsibilities in their society which are allocated on the basis of their sex.

2.3. **A real question**

Despite all these distinct advantages of geothermal development and the fact that geothermal utilisation can be tailored to improve the adaptive capacity of particularly the nomadic communities in Kenya's Rift Valley, vast resources remain unexploited and ironically, there are reported cases of community reluctance, or even hostility in some places in regards to geothermal initiatives, preferring instead to maintain the status quo and their traditional lifestyle. Should this attitude be attributed to the role played by thermal manifestations in the culture, religious and spiritual beliefs of local communities? Or is it caused by rumors or underlying, unfounded fears among the local population – such as that geothermal wells cause impotence among men? Or the notion that 'the government will take away the locals' land? This situation is evident, despite KenGen having clear resettlement and compensation packages that have globally accepted standards (Marrita, 2002). Could this be a pointer to a need for enhanced strategic communication with the local community?

Stories as the one narrated by Stephen Samoei Magut (an inhabitant of Kenya's picturesque and vast Kerio Valley for seven decades) for example indicate that the local community have a myth passed down through generations that the geothermal steam in the valley represents their departed forefathers who come down to earth to sleep during the night and go back to heaven at daybreak. How then would it be possible in such a context to make the community embrace the fact that the steam represents progress? This thinking represents that of a majority of the households; with poverty and low awareness as key reasons. Awareness raising and strategic information dissemination, thus communication is therefore critical for target local communities to benefit from geothermal initiatives (Kenya Energy Regulatory Commission).

There have also been various reported incidences involving the Kenya government administration and local communities around geothermal development sites as well as sites of other forms of energy with various enterprises and development agencies being implicated by the local communities. Some of these incidences have resulted in forced evictions, injuries, loss of property and even of lives.

This preceding scenario is indicative of the need for a well thought-out strategic communication, based on a solid understanding of the community's needs and expectations, involving not just the local community, but other relevant actors as well prior to implementation of the development initiatives. It also seems that there is community engagement before geothermal initiatives are started, but that community buy-in remains a challenge, pointing to the need to critically look at the way this communication is currently handled with the aim of enhancing its effectiveness. Experience has shown that engaging stakeholders early is critical to ensure broad support of projects among communities living in areas where geothermal resources are being developed.

Active, meaningful and inclusive participation of stakeholders is vital, meaning a deep understanding of their traditions and expectations, and in this case, particularly women, the gender that is traditionally in charge of water and energy issues. Awareness-raising at various levels is vital. This includes societal awareness raising to stimulate the market on the ground about the advantages and opportunities created by the use of geothermal. It is key that for social cohesion and in rural development, the process of identifying or creating essential systems, infrastructure, culture and traditions that benefit women should aim to engage and educate all genders through various communication channels that are also sensitive to the conditions of the various genders. The aim should be that resisters become supporters and thus agents of social change.

3. THE "GEOTHERMAL VILLAGE" CONCEPT

3.1. Background

Nearly 77% of Kenyans are not connected to the grid so lack access to regular electricity and modern energy services. This scenario impedes social and economic growth efforts as energy is a prime driver of development so has an impact on among other things, the attainment of the Millennium Development Goals (MDGs). As an example, there is obvious development disparity between Kenya's south and central rift (with electricity) compared to north rift (where there is limited and scattered electricity). East Pokot still relies on wood fuel and has illiteracy levels that stand at 90%. Women are particularly affected by this situation, as, within traditional communities in Eastern-Africa, the issues related to water and energy use and access remains their burden, as shown in Fig.4. The aim of this research is to show how, through a sound communication approach, women in target communities could become primary supporters of geothermal energy development.

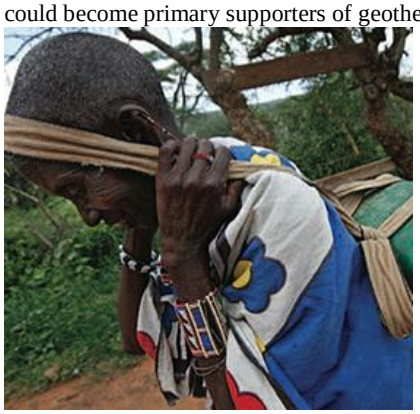

Figure 4: Woman from a Kenyan pastoralist community carrying fetched water

3.2. Objectives

The project (Omenda et al. This volume) is aimed at valorizing natural resources available on a remote naturally outflowing geothermal site in a poor areas where at present people live at the first, nomadic, self-supporting stage of mankind organization. Such populations are particularly fragile, being isolated and directly depending upon climate for their food and water needs. Away from communication routes, from any facility like energy, water, health, education, they are directly subject to epidemic diseases, malnutrition, infant mortality and eventually famine resulting from climate change.

In the concerned regions, the earth surface is particularly rugged (hard, black, lava surfaces, soft tuffs mobilized by wind storms…), affected by faults scarps, open fissures, and volcanic reliefs that cut routes and limit the facilities for land communication. The water infiltrates and is not available at the surface except when heavy rains result in flooding. However, these "bad land" contain natural resources that can be mobilized (Fig.5). The aim is hence to enable development of small-size local geothermal units thus valorizing the whole resource available through "cascade use" of the energy. The uses range from the upper electricity production, to the heat, cooling and freezing applications; down to the direct economic valorisation of the mineral water.

3.3. Local populations interest

As a matter of fact, more than for other renewable energy options, some of the applications of the geothermal resources are already familiar to local populations on site. Human settlement in EAR desert area is frequently on the site of geothermal emergences as the ground here provides humidity for vegetation growth, water for cattle breeding or for drinking (eventually by steam condensation of the fumaroles), and facilities for other services (washing, treatment of specific diseases…). The degree of appropriation of the resource by the local communities can hence be quite high, even with artisanal digging of thermal wells and pools, and construction of local facilities (like steam condensation and mineral water collection, see fig. 7). However it also happens that geothermal resources exist that have not yet been subjected to local usage and appropriation, especially when usable surface manifestations are weak or lacking[1]

Hence, the implication of the local population may differ from solar, wind or mini-hydro energy solutions which need to be wholly "imported" with respect to pre-existing habits. Such small-scale geothermal energy development project can effectively only be developed with the close involvement of concerned local parties. The success of such initiatives therefore relies upon the direct interest and mobilization – once involved – of the local population. Although this "natural appropriation" of the geothermal resource has to be improved by disseminating proper information and training to the community in regards to modern uses and technologies, local participation and governance at all stages of the project is a determining cause of success for the "Geothermal Village" project concept.

3.4. Social studies

The social dimension is necessarily a starting point, or at least part of the initial stage of the reconnaissance study, as the first objective is to answer the needs of the local population. This implies collecting, on each site, information concerning:

- The number of people living on the site, at proximity, and eventually people affected/targeted by the project.
- The activity of the local community on site, and the way the water and energy will modify (i.e. improve) their lives.

[1] Hydrothermal surface manifestations are not only liquid or gaseous, but may also consist of mineral deposits (as silica or carbonate), alteration products (as clays), or phreatic explosion craters showing the presence of high temperature fluids underneath.

- The gender issues, as women are generally in charge of water and energy (wood- supply) in these communities, and the way to handle the resulting changes.
- The need for electricity and water for crop cultivation (irrigated perimeters, greenhouses), fish farming, food conservation (drying, cooling).
- The relations to regional and central government on these issues.
- The general conditions, the access to the site, as well as safety conditions.

Figure 5: Some photographic views of present conditions in arid areas on the EAR : water well, Tum village main street, typical housing

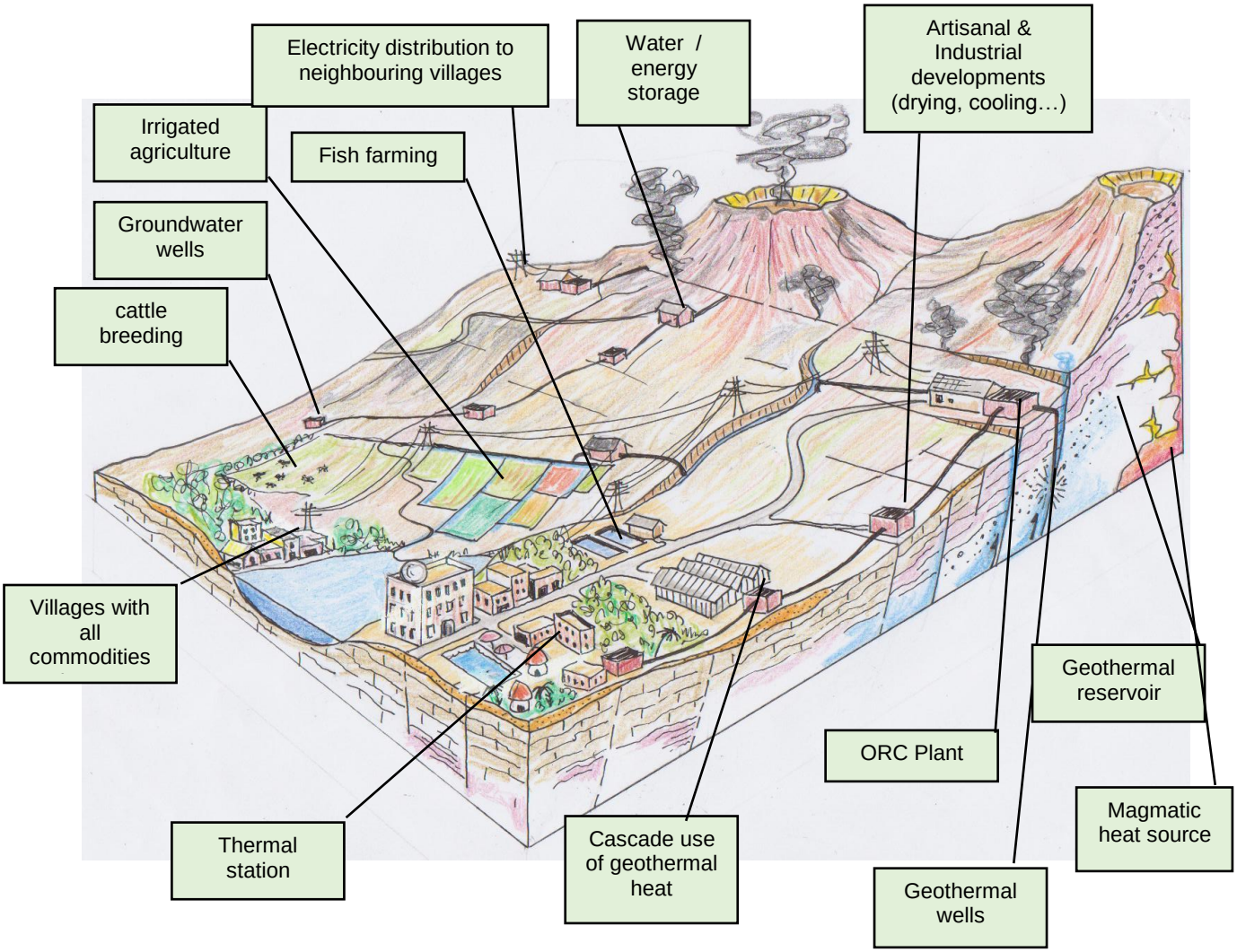

Figure 6: Scheme summarizing the "Geothermal Village" concept to be implemented at Barrier (Omenda et al. this volume). The plant uses shallow geothermal wells and the low temperature source is provided by groundwater extracted from shallow aquifers with production wells and pumping. Besides feeding the local needs and nearby villages through an electric network, the electricity is used in non-peak periods to pump the groundwater both for plant watering and other uses, and also for large storages in tanks located on the upper hills above the village. The geothermal fluid is, after first heat extraction for the electricity production, also used for thermal applications (drying food and agricultural products, green-housing, fish farming…) through successive heat exchangers, as well as, at the end of the pipe, for direct thermomineral applications (including local uses –such as swimming pools - and touristic developments).

3.5. Adapted technological solutions

The various possible technological options are considered on the geothermal site through an inter-disciplinary team work:

- Geo-scientific investigations to be achieved in order to site and determine the targets in terms of depth.
- Drilling activities to be engaged for catching both geothermal fluids at the convenient temperature and groundwater to be pumped out.
- Choice of the type of binary ORC plant to be installed in order to both respond to the electrical needs and adjust to the resource expected character.
- Type of low-enthalpy applications to be developed: cascade use of thermal energy for food drying, green-housing, or other thermal applications (i.e. eco-tourism).

With the identification of both groundwater and hydrothermal resources on site, as well as with the engineering approach the socio-economic conditions to be met for success will be established. The project will finally enable:

- the development of new irrigated land allowing for new crop cultivation and/or an increase of productivity of the existing ones (both cattle breeding and crops cultivation).
- the production of local combined energy production devices (electricity from small portable ORC plants, heat for food drying and food conservation)
- hydrothermal fluids production for bathing medical and other sanitary applications including sustainable touristic developments

The project is expected to radically contribute to improved socio-economic life of communities around the site. Additionally, as in the target area, the highest workload and family responsibility lies with women in charge of energy and water issues, women will particularly benefit, given their role thus gender issues will be addressed. The results of the research would also contribute to the core aims of regional programs, including African Rift Geothermal (ARGeo) programme run by UNEP for replication at regional level (Eastern-Africa).

Cascade use of the thermal properties of the resulting geothermal fluid will involve more familiar developments, but at an unprecedented scale. Sanitary and environmental conditions, even if not experienced, will be welcomed and preserved once the system is properly installed. Additionally, at the end of the pipe, the direct use of the geothermal fluid balneotherapic properties, previously lost, will be recovered, thanks to the heat exchangers. Artisanal or even industrial applications will make the population proud of this successful development. This will help contribute to green tourism development (ecotourism, local product sales, bathing and recreation…).

The dissemination of the information to the local population, its association to the various aspects of the construction and maintenance using proper training is essential. This approach will induce the permanent presence of the local population on the site, and will facilitate continuous development of the local energy and water grid, through modular steps, as a result of increasing local needs.

4. OUR GENDER APPROACH TO GEOTHERMAL: FROM LOCAL TO GLOBAL

4.1. Statement of Problem in Kenya

In Kenya, most of the sites suitable for geothermal developments are found along the Rift Valley, in areas primarily inhabited by pastoralist (nomadic) communities, mainly living on less than a dollar per day. Owing to the arid conditions of most of these areas as well as the traditional gender roles and consequent division of labour, women and girls - the traditional water-collectors and frequently the food producers—often have to walk long distances in search of water and energy sources (especially firewood). Men on the other hand travel in search of pasture and during the dry season, have to herd their cattle to distant pastures, and at times as water becomes increasingly scarce, end up bringing home the dying cattle for women to hand-feed. The men are also in charge of the negotiations with outside bodies (like Kenyan government authorities in case of geothermal development).

Despite the fact that the geothermal projects could provide an unending supply of these same resources closer to the community, thus save on time and energy that they can then spend in other useful activities, as well as open up profitable socio-economic potentials, there is often a general lack of buy-in of geothermal projects by the communities around areas with geothermal potential in Kenya. This situation results in tension and conflict between the development agents and the local communities around the sites at the onset of the initiatives and has in some instances, even degenerated to disputes that compromise the security of involved parties and even led to deaths of some community members. It further means that such initiatives lack community support, a key principle for sustainable development.

There is therefore a need for the development agents to gain an understanding of the socio-economic factors that contribute to this reluctance, and based on this knowledge, develop measures that promotes long-term community acceptance and sustainability of geothermal development initiatives. The proposed approach will therefore explore ways of enhancing an effective approach between geothermal development agents and target communities for successful projects in selected Kenyan rural communities. The premise is that women (and by extension the gender issue) is presently a missing link in these initiatives and could play a major role in the development of a constructive attitude towards the development of geothermal projects.

4.2. Rationale of the Study

Effective communication is vital in facilitating a common understanding between local communities and development agencies for sustained development prior to starting the initiatives. A common understanding will translate to cohesion between the stakeholders during the project development and implementation, and promote the stability, success, support and sustainability of

geothermal projects at community level. Geothermal development projects have implications on gender roles and gender relations. Developing a communication framework that takes into account gender considerations is thus imperative for sustainable community development.

4.3. Purpose of the study

To develop an effective gender-based communication model, based on identified socio-economic attributes of local communities living around areas with geothermal potential. The data collected will also inform the baseline survey for the sites with potential development. The aim of the study is to later feed and be incorporated in the Environmental, Social and Economic Impact Studies (ESEIS) documents targeting funding agencies, relevant government Ministries (Energy, Rural Development, etc), regulatory authorities, development agencies and consultants.

4.4 Initial findings

There are underlying social, economic and cultural reasons that contribute to the reluctance of communities in geothermal potential areas to readily accept geothermal initiatives and effective communication with a gender approach can be used to improve this situation.

REFERENCES

Bessette, G.: People, land and water. Participatory Development. Communication for Natural Ressources management. *IDRC. Earthcan, Ottawa* (2006) 313p.

Di Pippo, R.: Small geothermal power plants: design, performance and Economics. *Geo-Heat Center Oregon, Quarterly Bull.* **20, N°2** (1999).

Di Pippo, R.: Geothermal power plants: principles, applications, case studies and environmental impact. *2nd ed, Elsevier, New York.* (2008).

Enthingh, D.J., Easwaran, E. & McLarty, L.: Small Gothermal Electric Systems for remote Power. *Geothermal Resources Council Bull.* **23, N°10** (1994)

Galanis, N., Cayer, E., Roy, P., Denis, E. S., & Desilets, M.: Electricity generation from low temperature sources. *Journal of Applied Fluid Mechanics*, **2(2), 55-67,** (2009) 1735-3645.

Geothermal Energy Association: Geothermal International market overview report. Available from GEA: http://www.geo-energy.org, (2012)

Goguel J. & Varet J.: article "Geothermie" *Encyclopedia Universalis* (regularly revised);

Lund, J.W., Boyd, T.: Small geothermal power project examples Geo-Heat Center. *Geo-Heat Center Oregon*. Bull., 26p.(1999)

March C, Smyth I, Mukhopadhyay M: A guide to Gender-Analysis Frameworks: *An Oxfam Publication: Oxford, Oxfam Print Unit*, (1999)

Mariita, N.O. The Socio-economic and Environmental Impact of Geothermal Energy on the Rural Poor in Kenya. Report AFREPREN/FWD (2002) 47p.

Mariita, N.O. An Update on Applications to Direct-uses of Geothermal Energy Development in Kenya. Proc. World Geothermal Congress (2010) 5p.

Omenda, P.: Geothermal Exploration in Kenya, *UNU Reports, Reykjavick* (1989, 1991)

Rafferty, K.: Geothermal power generation; a prime on low-temperature, small-scale applications. *Geo-Heat Center, Oregon,* 12p. (2000).

Varet J.: Géothermie basse énergie : usage direct de la chaleur Coll. Les Objectifs scientifiques de demain. *Ed. Masson Paris. 1 vol. 201 p.* (1982)

Varet, J.: Feasibility study and the implementation of the Fang ORC Plant (Thailand) for EGAT, the electric authority of Thailand. *BRM/CFG Report*, (1984)

Varet J.: Risorse geotermiche e loro sviluppo in aree di bassa e media temperatura: esempi della Francia. *Atti del convegno il Calore della Terra, Piancastagnanio,* (Siena, Italy) 6p. (2012).

Varet J. : La géothermie en milieu rural, *Revue POUR*, (Paris) 11p., (2013)

Varet J.: La géothermie en Afrique de l'Est. *Encyclopédie du Développement Durable* http://encyclopedie-dd.org/varet-jacques.html (2014)

Vimmerstedt, L.: Opportunities for small geothermal projects : rural power for Latin America, the Carribbean, and the Philippines. *National Renewable Energy Laboratory report. NREL/TP-520-22792, Golden,Co.*, 65p.(1998).

Websites dealing with social-gender issues linked with geothermal :

http://unu.edu/publications/articles/making-a-difference-through-geothermal-energy-2.html
http://www.thinkafricapress.com/kenya/biggest-geothermal-project-continent-spurs-hope-among-locals
http://thinkafricapress.com/economy/potential-energy-tapping-africas-renewable-resources
http://thinkafricapress.com/environment/africa-green-economy
http://dissertationrecipes.com/wp-content/uploads/2011/04/Creating-the-Problem-Statement.pdf
http://www.theguardian.com/global-development/poverty-matters/2013/nov/22/kenya-geothermal-power-energy-revolution
https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2013/Sutter.pdf
www.un.org/africarenewal Rio+20
http://www.uncsd2012.org/rio20/index.html
http://harare24.com/index-id-news-zk-13244.html#sthash.eXrtm3Tw.dpuf
http://harare24.com/index-id-news-zk-13244.html
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48396/5507-cmci-nairobi-workshop-summary.pdf

http://intercontinentalcry.org/forceful-evictions-of-maasai-leave-homes-burned-and-thousands-homeless-in-naivasha-kenya/http://intercontinentalcry.org/kenya-forceful-evictions-of-maasai-from-narasha-a-recipe-for-tribal-clashes-19921/?replytocom=243368#respond

http://www.climateinvestmentfunds.org/cifnet/sites/default/files/Kenya%20Menegai%20Geothermal%20Development%20Project%20Supplementary%20Doc%20-%20Approved.pdf
http://intercontinentalcry.org/forceful-evictions-of-maasai-leave-homes-burned-and-thousands-homeless-in-naivasha-kenya/
http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTENERGY2/0,,contentMDK:23338508~pagePK:210058~piPK:210062~theSitePK:4114200,00.html
http://thinkafricapress.com/kenya/electricity-king
http://thinkprogress.org/climate/2012/09/09/512010/budding-geothermal-markets-light-up-east-africa/
http://dissertationrecipes.com/wp-content/uploads/2011/04/Creating-the-Problem-Statement.pdf
http://www.energia.org/fileadmin/files/media/reports/KenyaGenderFlyerTIE-ENERGIAfull.pdf
http://www.energia.org/fileadmin/files/media/reports/Kenya_gender_audit_report.pdf
http://nai.diva-portal.org/smash/get/diva2:274405/FULLTEXT01
http://www.sv.uio.no/iss/english/research/projects/solar-transitions/about/
www.scode.co.ke/Review.doc
http://www.worldbank.org/en/country/kenya/overview
http://www.unep.ch/etb/areas/pdf/Kenya%20ReportFINAL.pdf
http://geothermal.org/PDFs/Articles/10MarApril24.pdf
http://www.os.is/gogn/unu-gtp-sc/UNU-GTP-SC-04-16.pdf
http://www.fig.net/pub/fig2010/papers/ts01e%5Cts01e_oduor_3857.pdf